TROPICAL AGRICULTURE

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CONTENTS.

	PAGE.
Agriculture and Mining	129
Engineering	130
College Course in Sugar Technology	131
The Habit of Budded Cacao	132
Artificial Farmyard Manure	133
Mycology	134
Mycological Conference	134
Applied Economics	135
The Tropical World	136
Estate Accountancy	138
Position of Fibre Production	140
Prevention of the Over-Enlargement of Heads of Pine	142
The Smithsonian Institute	142
Origin of Sugar Cane Seedling D. 1135 ...	143
College News	143
Airships versus Aeroplanes	143
Trend of the Markets	144
Over-Production	144

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AGRICULTURE AND MINING.

THERE was a phrase in common usage some twenty or thirty years ago, and still not obsolete—the phrase "wheat-mining in Canada." These words are full of significance, not only to the agriculturist but also to those whose interests may in no way be directly connected with the soil. Clearly "wheat mining" suggests "taking out without putting back" or in other words depletion, and in its wider aspects opens up instructive considerations as to the parallelism between the two great fundamental industries of civilization—agriculture and mining. In the first place both, at any rate in their initial stages, are rural industries, for although it takes some stretch of the imagination to regard a developed coal-field as rural, many mining fields are extremely rural, far more so than the conditions surrounding the Fen potato farms of northern England or the immediate environment of a large central sugar-factory in the tropics. The chief parallelism between agriculture and mining lies in the fact that they are extractive industries both subject to the laws of diminishing returns. Beyond a certain point every additional "dose" of capital produces, other things being equal, a smaller return than the previous one. But whereas in mining the resources of the earth can never be replaced by man, in agriculture they can, though this is not, by any means always done, as for example under the "wheat-mining" conditions of Canada or under the cacao-mining conditions of Trinidad. In respect of "intensity" and "extensity" there is a remarkable correspondence between the two classes of industry, the comprehension of which requires some knowledge of what different mining conditions are like. The alluvial diamond fields of British Guiana which are "worked" by individual speculators under the roughest un-organized and primitive conditions, are distinctly extensive, whereas some of the fields in South Africa operated by a controlling company are highly capitalised and intensive. A still more striking contrast is to be seen in the alluvial gold fields and the accurately "costed" operations in highly-capitalised mines—also in South Africa. They have a high degree of permanence, an attribute which is wrongly considered as a monopoly of agriculture. Indeed, agriculture, economically, may be very transient: the coffee industry of Ceylon was wiped out by disease in a very short time. The sugar industry in many West Indian Islands was given up on account of economic and political causes. In agriculture, the soil is not everything. But perhaps it is in the case of oil that the most striking conditions of extensity and intensity prevail. Oil is not so fleeting as some people think. Certain fields, supposed by the public to have been depleted, have in fact merely been exploited with shallow wells and no precaution taken as to water seepage from water-sand strata to oil-sand strata—one of the great problems of intensive oil-mining. Had they been more scientifically and conscientiously worked these fields would still be producing. Anyone having the most elementary knowledge of agricultural conditions will recognise the parallelism: in mining the exploitation of alluvial or shallow deposits of diamonds, gold, oil, tin, and coal; in agriculture the exploitation of virgin land—very often alluvial, be it noted, in the tropics—without manuring or cultivation. And just as it is difficult and expensive to get a ruined oil field back into profitable production, so is it difficult and expensive to rejuvenate a depleted soil or exploited forest. But depletion unavoidable and often (economically) complete

in mining need not occur at all and is never biologically complete in agriculture. Wheat has been grown on Broadbaulk field at Rothamstead without putting anything back on the land for 85 years. The yields have not been economic but have nevertheless remained fairly steady. Thus agriculture has chemical and biological cycles. Plants grow principally not on the soil at all, but on the gases of the air. It is this biological and chemical cyclic gaseous phase which marks agriculture as compared with mining. Yet coal produced from tropical vegetation in the Carboniferous Age and oil, probably derived from the decomposition of marine organisms, are also biological and cyclic on a vastly slower and larger scale. These are considerations of Nature. Equally arresting are the purely economic contrasts in regard to the monetary aspects of agriculture and mining. In the annual report of a Nigerian tin company issued a few weeks ago, it is stated that the working profit was £40,769 in 1923 as compared with £10,334 in 1922 due (*a*) to 205 tons increase in output, (*b*) to reduction in working costs of £5 14*s*. 2*d*. per ton, (*c*) to an increase of £37 15*s*. 7*d*. per ton in the market value of the concentrates (treated ore), and that the reserves of ore are worth £200,000 and that the Company is proceeding to buy a suction cutter dredge costing £26,000. Here is a case of intensive mining. The reserves cannot be secured except by the expenditure of large amounts of capital and the application of scientific knowledge. Such mines may continue for many years. The tin mines of Cornwall were worked by the ancient Britons and are still worked to-day. As in agriculture, profit in mining depends upon the inter-relationship between cost, yield, and market price. The above Company did not depend upon market price which in a boom might mean a profit even with high costs and poor yields. It concentrated on reducing unit costs and apparently upon expert knowledge enterprise, and intelligence in order to increase the yield. Facts like these are available in agriculture, but they are not studied sufficiently in many agricultural communities. In any case it is the parallelism that concerns us here and consideration of other economic factors emphasizes still more strongly its existence and significance. Mining and agriculture, for instance, both produce by-products and in both the question often arises as to whether a by-product is a main product and whether a main product is really a by-product. Petrol was burnt in Sumatra thirty years ago because the world had no use for it. Kerosene (or paraffin) was the main product, for burning in lamps. A few years ago molasses, a by-product of sugar, was run into the sea and in the windmill days megass now supplying all the energy needed to drive huge steel roller mills was completely wasted. The determination of the costs of producing these by-products is both in mining and agriculture an extremely difficult and controversial matter involving expert technical knowledge for proper solution. Great advantage has accrued at the Imperial College of Tropical Agriculture in contrasting mining accountancy with agricultural accountancy. Benefit can be also derived from a study of the respective systems of distribution and marketing in mining and agricultural industries. The law of supply and demand operates broadly in both mining and agriculture, but there are local oil monopolies and, as is well known, almost complete monopolies in respect of some precious stones and bananas. As to the factors of Nature causing variation in output in a mine or on an agricultural estate we have water as a common factor of the highest importance. Water is the bug-bear alike of the oil driller and of the tropical planter in rainy districts. Yet on the other hand we find that copious water is needed for working the tin mines of Nigeria and for irrigation in Hawaii. It is the *control* of water that is the essential problem. Climate naturally affects agriculture to a far greater extent than it does mining, yet in respect of ill-health, miners have their specific diseases just as agricultural labourers and plants have theirs. Hookworm is typically common to both industries. Concerning technology, mineral ores require chemical extraction just as sugar-cane or beet-roots do. As modes of life, mining and agriculture have very similar problems and the physio-psychological study of agricultural conditions especially in the tropics demands just as much investigation as has been devoted to psychological problems of environment in respect of mining, especially coal-mining. Evidently the miner and the agriculturist have something fundamentally in common which is unique, and this also holds good in respect of the capitalist who directs the many and highly varied commercial concerns of these great industries. Perhaps the greatest lesson which is sometimes overlooked, lies in the fact that the mining industry as a whole necessarily recognises depletion and especially in the case of oil includes it as a cost of production. If this principle were more fully recognised in agriculture —even if merely as a principle—it might make many an individual or planting company or even a whole colony pause for a while and think, leading ultimately to the adoption of better methods and sounder policies having adequate regard to the needs and exigencies of the future.

ENGINEERING.

A New Water-Pump.—A new type of water-pump that can be operated by waterfalls of no great height, and yet can lift water to high levels, has created great interest at the British Empire Exhibition. The pump is known as the Hydrautomat, and is manufactured by the Hydrautomat Company, Ltd., of Victoria Station House, Westminster, London. The principle on which it works involves compressed air in a very ingenious manner, and the machine whilst very simple in construction, works efficiently even with the smallest heads of water. It is safe to predict that the Hydrautomat pump will find world wide use for such agricultural purposes as irrigation and drainage.

COLLEGE COURSE IN SUGAR TECHNOLOGY

PROFESSOR O. F. BOYD, B.A. (UNIVERSITY OF LA.)

It will be generally agreed that the Imperial College of Tropical Agriculture, in establishing a course in Sugar Technology, has done a very wise and helpful thing for the West Indies, and the sugar producing world at large. There are only two or three sugar schools in the world where one can receive specialised training in sugar technology, and there is always a great demand for trained sugar technologists and specialists. Scientific production has been sadly lacking in the past in cane sugar manufacture, and is not to be compared with the strict chemical and technical control in use in beet sugar factories.

The world's supply and demand of sugar is constantly increasing and although they may fluctuate yearly slightly, the production has been on the upward trend for the past thirty years. The importance of a scientific, technical and chemical control of the factory and field work is being recognised and acknowledged more and more every year. The old slipshod methods of "rule of thumb" are being cast aside for the more modern methods of chemical control and scientific cultivation.

The purpose of the College course in Sugar Technology, which will be pursued this year for the first time, is to train technologists in the manufacture of sugar in all of its various phases, and to give them a thorough practical and theoretical knowledge of the principal processes of fabrication. To this end, the College has been fortunate enough to secure an appropriation for an experimental factory, which is being erected on the College grounds at the present time. The factory will be in actual operation this coming grinding season, and will be completed within a month or two. It has been so designed and erected that numerous experiments are possible. Various processes and methods can be carried out without any material alteration being made in the machinery. The capacity of the various units in their relation to the milling capacity are sufficiently large to allow extreme flexibility in the various processes of manufacture. The desirability of this condition is obvious. The factory can be converted into one of almost any type within a reasonably short length of time, and hence the type or grade of sugar being manufactured can be altered at will. Arrangements have been made to convert the factory into a small refinery and thus enable it to refine part, or all, of its own raw sugar. The machinery is of the latest type, and is partly a gift of the various manufacturers of sugar machinery in Great Britain. The building is of steel construction and fireproof.

The magnificent opportunities for actual practical experimental work are easily recognised, and it will be the aim and purpose of this department to take advantage of them.

A complete course of lectures on sugar manufacture in all of its various phases, will be given, the various processes for manufacturing the different grades will be described and studied, and arguments presented as to their merits and demerits. As the lectures upon the manufacture of sugar in its various phases and processes are given, their practical accomplishment must be carried out simultaneously in the factory and analyses made in the laboratory of the juices, syrups, molasses, &c, and a complete routine established. In this way an actual demonstration of the process accompanies the lecture and laboratory work. It will be the aim of this department to combine as much as possible the theoretical and the practical side, which in turn will make an understanding of either feature infinitely simpler.

This plan will obviously offer numerous opportunities for study and research. It is the intention of this department to use every process possible and to keep a strict chemical control on the factory at all times, so that various comparative data may be obtained. The laboratory work will be conducted exactly as it is done in a larger factory working on a commercial basis, and a close check kept upon losses and yields. A system of sugar factory bookkeeping and report work will be installed similar to those in use in the most modern factories to-day. For the present it will only be possible to instal a very small factory laboratory and this room will be used for controlling acidities and alkalinities. The analysis and routine work will take place in the laboratory in the College building, which has been especially equipped for that purpose.

The construction of the machinery and the elementary principles under which the various units operate will be treated under a course in "Chemical Machinery." This course will be required of both second and third year students. A study of the principles of boiler construction, steam, horsepower, heat units, &c., will be included in this subject. Comparative fuel values, and fuel economy of various processes is an important line of study in any industry and this will be introduced into this course.

The Agricultural Engineering Course will be partly taught by the Agronomy department. It will consist of a series of lectures on the use of farm implements, tractors, haulage, irrigation and drainage problems.

A two-year course in Spanish will be offered to students of Sugar Technology and will be compulsory. The course will be open to any student who has reached the second year. The importance of a speaking knowledge of Spanish to one engaged in any phase of the sugar industry is quite manifest. It is practically essential that factory superintendents, engineers and chemists, engaged in the industry in Spanish speaking countries, be able to speak the language. Students will be also encouraged to obtain if possible a working knowledge of Dutch. And as soon as one who intends to

follow sugar work begins to study the elements of the language, the quicker and more readily is a speaking knowledge acquired. Nearly 50 per cent. of the world's sugar supply is manufactured in Spanish speaking countries, and in Cuba alone, over four million long tons will be produced this year. One who is to be trained in sugar technology cannot therefore expect to have completed his training without a knowledge of the above languages spoken in the largest sugar-producing countries. The importance of a working knowledge of these foreign languages is often overlooked in respect of other branches of tropical agricultural science, and their inclusion in the curriculum is likely to serve a generally useful purpose in the College instruction.

The micro-biology and the study of the fermentation of molasses will be taken up by the micro-biological department. This knowledge is very necessary as numerous distilleries are run in conjunction with factories, utilising the waste molasses for the manufacture of alcohol and rum.

The economic and accounting phase of the industry will be gone into by the economics department, and statistics will be furnished of yields and losses by this department. In this manner estimates of the comparative costs of production expended in various processes can be arrived at, and statistics compiled.

In summarising briefly the foregoing :—the objects and purposes of the course are to furnish theoretical and practical instruction in the manufacture of sugar. This instruction is to be accompanied by practical factory and laboratory demonstrations, and by operating the experimental factory under the same conditions as a larger factory would operate upon a commercial basis, especially in regard to labour and fuel. The results obtained from experimental demonstrations would therefore be comparable with those in a parallel case in a larger factory.

The opportunities for research work and investigations of various conditions in the factory are manifold, and every encouragement and co-operation will be offered to anyone, not connected with the college who is interested in any phase of the manufacture of sugar and cares to go into any of its numerous problems.

It is the intention of this department to give lectures frequently upon various subjects of interest to those connected with the industry. The public will be invited to attend these lectures, and it is hoped that estate owners, engineers, chemists, overseers, pan-boilers, and anyone in the least interested will do so.

A thorough co-operation with the local factories will be undertaken and a study of local conditions made, with a view to building up a feeling of co-operation which will tend towards helping the students, the staff, and those connected with the industry to a possible solution of problems, with a mutual benefit to all.

THE HABIT OF BUDDED CACAO.

PROFESSOR S. C. HARLAND, D.SC. (LOND.), and R. G. PARGA, B.A. (OXON.).

One of the most striking features of the plots of budded cacao at the River Estate of the Trinidad Department of Agriculture, is the low, spreading habit of the trees, and the absence of the chupon or water sucker type of branch. As is well known, the cacao tree grown from seed has two kinds of branches, which differ in the arrangement of their leaves : these are respectively the main axis type or chupon, and the fan or palm type. A young cacao seedling produces first a vigorous main axis, which sooner or later divides into five branches, known in Trinidad as the "jorquette."

The main axis can be carried on by a bud which arises on the main stem just below the jorquette. This grows upward and after a time divides into about five branches as before.

This method of growth can be repeated until a three or even "four storied" tree is formed. A tree with more than one "story" is much favoured by some planters, while others prevent the tree from making more than one jorquette. The five branches into which the main axis terminated are of the fan or palm type.

The cacao tree is thus dimorphic in its branching system, and the two kinds of branches, chupon and fan respectively possess a different arrangement of the leaves. The chupon has leaves arranged round it according to the formula $\frac{3}{8}$, that is if one looks at two leaves, one immediately above the other, a spiral round the stem can be traced, the spiral going three times round the stem, and passing seven leaves in its course. The fan branches have apparently the formula $\frac{1}{2}$, that is the leaves are arranged alternately on different sides of the branch.

In the adult tree chupon branches often arise from below the jorquette, and may also arise upon the side branches, or secondary side branches, but this latter case is somewhat rare.

Fans have no definite termination, but at the end of each season's growth the terminal bud becomes dormant, again growing out the next season. Chupons, however, invariably terminate in the usual five branches, all of which behave as fans.

Returning to the habit of budded cacao, it will be noted that the branching habit is not dimorphic, but monomorphic, the only kind of branch produced being the fan. The two-storied tree favoured by some planters is thus impossible with ordinary budded cacao, and equally impossible is the main axis jorquette type. The writer has examined large numbers of budded trees and only on one occasion has the presence of a chupon branch been noted.

The above series of facts led us to consider whether the prevailing habit of budded cacao is due to the type of bud used for budding, and on

enquiry it was found that buds are invariably taken from fans, and not from chupons. Without going any further then, the conclusion is obvious that monomorphic (fan) trees result from the use of buds from fans. Since a bud in the dormant state is already fully differentiated, a simple way of finding out what it will develop into is to make it sprout by cutting off the whole of the branch immediately above it, and an extensive series of pruning experiments have been carried out on both fans and chupons. The object of the experiments was to determine under what conditions, if any, a dimorphic type of budded cacao could be produced, *i.e.*, a budded cacao with the same habit as seedling cacao.

Summary of the Experiments.—(1) Fans when pruned back generally produce fans from the topmost bud and any others which develop. (2) In certain circumstances fans can produce chupons. Out of 59 pruned fans, 57 gave fans, and 2, both from the same tree, gave chupons. (3) Chupons generally give chupons after being pruned back. Out of 40 prunings, 24 gave rise to chupons, and 9 to fans; the rest remained dormant. There is some doubt as to whether the chupons which produce fans were really chupons, for some branches when young may appear to have a chupon leaf arrangement and afterwards turn out to be fans. On close examination of the chupons which gave fans it was concluded that there was no clear case of a chupon which had already forked producing a fan after being pruned below the fork. Further experiments on this point, however, are in progress, and it must be strongly emphasized that anyone who desires to find out whether chupons can form fans, should make use only of chupons which have already forked.

Discussion.—From the results of pruning experiments it is clear that if buds for budding are taken from chupons instead of fans, an entirely different sort of tree will result, resembling the seedling in habit. This should be termed dimorphic budded cacao, to distinguish it from the ordinary type. Which of the two types is agriculturally the better should now be the subject of experiment, but even in the present state of knowledge it is possible for a planter to grow budded trees of the habit which he prefers.

ARTIFICIAL FARMYARD MANURE.

In the last issue of this Journal, a description of the preparation of pen manure by the Mauritius method was given. In this process of making manure, the urine of farm animals is employed as a bacterial starter. Its addition to cellulosic litter, such as straw or cane trash, enables certain organisms that are capable of decomposing cellulose to get to work and to multiply. Mention was made in the article cited of another method of making pen manure in which even a urine starter is omitted. This method is the Rothamsted artificial manure process, now known as the Adco process. The starter employed is ammonium sulphate. This is added in solution to cellulosic material which has previously been soaked with water. In order to neutralize acidity that develops as the ammonium sulphate is utilized by the cellulose-decomposing organisms, calcium carbonate (ground limestone) is previously mixed with the material. Recent information indicates that the Adco process has more than realized anticipations in England. It is of interest to tropical agriculturists to note that successful attempts have now been made to apply the process to the manufacture of artificial pen manure from sugar-cane trash. The following information on this point is taken mainly from the *Australian Sugar Journal*, for April 4th, 1924.

As a result of correspondence, the Scientific Staff of the Agricultural Developments Company of Harpenden, Herts, agreed to experiment with cane-trash as raw material for making artificial pen manure. The experiments successfully demonstrated that a satisfactory product could readily be prepared from trash. This product compared favourably with ordinary English farmyard manure when tested in pot cultures. Furthermore, its analysis showed that it was even superior to Adco manure made from straw, in nitrogen and potash content, and in content of organic matter, though somewhat inferior in phosphate. In 1923, the Adco Company shipped to Queensland, 10 tons of their standard Adco mixture*, which is sufficient to produce 400 tons of artificial manure from 150 tons of dry cane trash. This mixture costs £21 per ton c.i.f., delivered in drums at Brisbane. The Adco Company is prepared to grant licences to work their process, as protected by their Australian patent. Large scale trials are being carried out in Queensland, in order to determine whether or no the process is practically advantageous when applied to actual sugar-cane growing. The results of these trials, and of others that are doubtless being attempted in other parts of the tropics, will be awaited with great interest.

A brief history of the Adco Company is not out of place at this juncture. The Rothamsted researches on cellulose-decomposing organisms were commenced by Dr. H. B. Hutchinson in 1917. They were briefly mentioned by the Director of the Rothamsted Station, Sir E. J. Russell, in the August number of the Journal of the British Ministry of Agriculture for 1919, and again in the August number of the same journal for 1920. A more detailed account of the work was given by Dr. Hutchinson and Mr. E. H. Richards in the August number of the Ministry's Journal for 1921. Field trials at Harpenden and Woking with artificial farmyard manure prepared under the direction of the Rothamsted workers

* The composition of this mixture is not divulged. Presumably it consists mainly of ammonium sulphate and calcium carbonate, since it is stated that all that is required in addition is a supply of water that can be suitably sprayed over the trash heap. The information explains that it is necessary in the process to supply "certain chemical stimulants" for 'bacterial growth' in order to obtain the best conditions for rapid cellulose decomposition.

had given satisfactory results for three consecutive seasons. Consequently, in 1921, in order to foster the employment of the process in practical agriculture, and to tide it over the difficult stage between the laboratory and the farm, Lord Elvenden generously provided the funds for the formation of a company, whose primary object as stated, is not to make profits for the benefit of its shareholders, but to try to develop as a business the manufacture of artificial farmyard manure from waste straw and similar material. The company was organized under the name of The Agricultural Developments Company (Pryford) Ltd., of 12, Spencer Road, Harpenden, Herts, England. The managing director is Mr. E. H. Richards, B.Sc., F.I.C.

To quote Lord Elvenden, " It has always been my ambition to see whether it is not possible to make certain branches of scientific research self-supporting ; and since any progress to this end requires the employment of a qualified staff, and the purchase of mechanical plant, persons participating in the advantages of the process may quite fairly be expected to contribute to the cost of development by a reasonable payment, either in the nature of a royalty, or otherwise . . . . . The royalties will be available after payment of expenses to form a fund for further scientific research along practical lines in agriculture."

F. HARDY.

MYCOLOGY.

OUTLINES OF FUNGI AND PLANT DISEASES : By F. T. Bennett, B.Sc. London : *Macmillan & Co.*, 1924. Price 7*s*. 6*d*. net.

This text-book makes no claim to be specially suitable for use in the Tropics. Part 1, headed " Fungi-General " introduces the study of Fungi by describing common types, and Part 2 deals exclusively with the plant diseases of importance in the British Isles. Within its scope, however, it is carefully prepared and commendable work. The figures are clear, and the introduction of a short bibliography at the end of the description of each disease adds to the value of the book to students who require rather more than " outlines."

E.E.C.

An order of the Ministers of the Colonies dated May 5, 1924, prohibits the importation, circulation, putting in bond and transport (except in certain cases, authorised by the Governor-General) of plants, cuttings and seeds of sugar-cane from any country into Madagascar.

Mention is made in the April issue of " La Indu tria Azucarera " of a new variety of orange, " Lue Gim Gong," the result of experiments carried out by the Agricultural Experiment Station of Tucuman. A special feature of this orange is that it can be obtained when this class of fruit is normally out of season. In Trinidad the orange season ends about May, being followed by the mango season which lasts until September.

MYCOLOGICAL CONFERENCE.

A conference of overseas mycologists organised by the Imperial Bureau of Mycology was held in London during the first week in July mainly for the purpose of reviewing the past and considering the future activities of the Bureau but also to discuss some of the broader aspects of economic mycology. It was agreed that the Bureau had been of great service to overseas workers during the four years since its inception and that it was desirable for supporting Dominions and Colonies to increase their contribution in order to secure an increase of staff and enlargement of the monthly abstracting publication—*The Review of Applied Mycology*. It was resolved also to recommend that a similar conference be held again in five years and that in order to promote the progress of Plant Disease Surveys in a number of the tropical colonies, a loose sheet should be issued at intervals recording determinations of materials, collectors' names and localities. The subjects submitted for consideration and actually discussed were :—

(1) Activities and organisation of the Bureau.
(2) Publications of the Bureau.
(3) Co-ordination of investigations on fungicides.
(4) Plant Disease Surveys in the Empire.
(5) Standardisation of popular and scientific nomenclature in plant pathology.
(6) Encouragement of industrial enterprise in the investigation of plant diseases.
(7) Diseases of tropical plantation crops.
(8) Influence of soil conditions on plant diseases.
(9) Practical application of the results of mycological investigation.

Of special interest to mycologists and other agricultural workers in the tropics was the discussion of some diseases of tropical crops, those selected being cotton, cacao, citrus and bananas introduced respectively by Mr. R. E. Massey from the Sudan, Mr. R. H. Bunting from the Gold Coast, Dr. Ethel Doidge from South Africa and Professor S. F. Ashby from the Imperial College of Tropical Agriculture. A very interesting discussion under the eighth heading was introduced by Mr. W. Nowell from Trinidad.

It may be added that discussions on Sugar-Cane Mosaic and Budrots of Palms were opened by papers by Professor Ashby and Dr. E. J. Butler, the Director of the Bureau, at the Empire Botanical Conference held during the succeeding week. This Conference was a non-official gathering of home and overseas workers interested especially in applied botany. A number of discussions and papers of a practical bearing were contributed on the breeding and selection of crop plants and the characters and control of their fungous bacterial and " virus " diseases.

APPLIED ECONOMICS.

RECENT CONTRIBUTIONS TO AGRICULTURAL ECONOMICS.—H. R. Tolley and S. W. Mendum (Bureau of Agricultural Economics, United States Department of Agriculture) describe and apply statistical methods of testing farm-management and cost-of-production data for validity of conclusions in *Department Circular* 307 (March 31, 1924). "Dot charts" are given showing the regression of a dependent variable on an independent variable, such as working capital on size of farm, profit on cost per lb., and cost per bushel on yield per acre in respect of a large number of farms. Consideration is given to the utilization of the rates and correlation co-efficients for estimating results on farms not included in the survey. In *Bulletin* 412 (Cornell University Agricultural Experiment Station), L. J. Norton gives a very detailed account of an economic study of the production of canning crops in New York State. Data were obtained both by the survey method (collecting existing data from individual farmers) and by the accounting method (arranging records and accounts for each farmer to keep). Cost items are carefully defined and a large number of tabulated averages are given. The crops dealt with are peas, Indian corn and tomatoes. A notable matter given special attention is the return per hour of labour and its cost per hour. In *Bulletin* 372 (Coll. of Agric., Agricultural Experiment Station, Berkeley, California) R. L. Adams deals with the cost of producing market milk and butter fat in 246 California dairies. It is claimed that a large percentage of these produced at a loss ("interest on investments" included as a costings charge). Labour and feed were the two outstanding cost items and economy is therefore likely to be most effective if directed on to these. A report on the development of agricultural costings in Denmark (*The Journal of the Ministry of Agriculture* of England and Wales, April, 1924) shows the great progress that has been made in establishing an organization to help farmers to keep proper accounts. The statistical value of the results obtained are clearly indicated in that they enable administrators to arrive at general conclusions as to what extent small, medium and large holdings are affected by varying economic conditions. In *Bulletin* 198 (University of Nebraska College of Agriculture Experiment Station, Lincoln), H. C. Filley gives an account of the general factors affecting the price of farm products. Those considered are: supply and demand, cost of production, market strategy, monopoly, money (value varying inversely to quantity in circulation), credit, transportation, commercial costs and import duties. Graphs are given showing the general relationship of price and production for a number of northern agricultural products. J. J. Blanden, Special Agent, Bureau of U.S. Bureau of Foreign and Domestic Commerce, is the author of *Trade Information Bulletin* 180 on the marketing of plantation rubber. This is the first of a series to be issued by the U. S. Government as a result of "the investigation of the crude-rubber monopoly authorised by the Sixty-seventh Congress." The methods and transactions on the European and Eastern rubber markets are simply given, the latter in greater detail than the former. The functions of the Eastern "Agencies" are described. On the subject of rubber production, consumption and prices, Owen Tomlinson (*The India Rubber Journal*, May 17, 1924), claims that the 60 per cent. restrictions will reduce surplus stocks (the essential need) and produce an average price between 1*s.* 3*d.* and 1*s.* 7*d.* in 1925 if 1*s.* 3*d.* be made the "pivotal price." According to the author, the present machinery makes 1*s.* the pivotal price. In *Bulletin* 422 (Cornell) Dwight Sanderson and Warren S. Thompson describe their studies of the social areas of Otsego County (New York) the idea being the demarcation, description and analysis of the significance of rural social groups or "neighbourhoods." Seven types of "neighbourhoods" were found to exist: the Hamlet, the Institutional, the Business, the Ethnic, the Kinship, the Topographic and the Village. The social areas are mapped and the methods of investigation described. Studies parallel to these are capable of being carried on with advantage in regard to tropical agriculture. Another and very comprehensive contribution to rural social science is *Bulletin* 423 (Cornell) on the standard of life in a typical section of diversified farming. The author distinguishes between standard of living (purely economic) and standard of life (pyscho-economic). Analytical statistical information is given in regard to points like maintenance of health, standard of education of parents and children, size of house, vacations and travel, purchase of literature. Education of parents and children is about as closely related to total values as is size of farm business. High "profitableness" of a farm is not always accompanied by a high standard of life. Coefficients of correlation are given. *The Journal of Farm Economics* (Vol. VI No. 2, Apr. 1924) contains several important papers, notably on elasticity of supply of farm products by J. D. Black, on agricultural forecasting by H. C. Taylor and on the law of the diminishing increment in the fattening of steers and hogs. Black's paper concerns the relation between price and subsequent output; the "bulk line" method of considering costs is discussed as well as the time of response to high or low prices, and the influence of tariffs and propaganda as factors. Mention is made of Prof. H. Working's coefficient between price and acreage under cotton in the United States, namely, $+\cdot62 \pm\cdot08$ (for the years 1883-1913). This was higher than for any other crop studied. The tobacco coefficient was the lowest. In conclusion the author of this paper claims that nothing will furnish reliable information except curves of elasticity of supply. This paper might be studied with advantage by British sugar, rubber, cotton and tea-growing interests.

W. R. DUNLOP.

TROPICAL WORLD.

'IRAQ.

The future of 'Iraq or Mesopotamia, "the land between the rivers" (Euphrates and Tigris), depends first upon the administration of the British mandate and peace with Turkey, and secondly upon agricultural development and trade. Both Persia and Syria are important markets of 'Iraq, and one of the present difficulties (now largely overcome by an efficient Camel Police Force) is the Bedouin raids, along the caravan routes across the desert, which have existed from time immemorial. In fact the early Bedouins, or nomadic Arabs, regarded the desert as their own property and traders as trespassers from whom they were entitled to extract a toll—if that word can be used for what was more often total confiscation and death. Railway development is one solution, and this is being actively pushed. The cultivation of cotton—the great agricultural hope—has as yet yielded very little traffic for the railways in existence, but the output is rapidly increasing and the railways are giving every facility for cotton-growing and even free passes to approved persons who wish to see the British Cotton Growing Association's Ginnery at the capital, Bagdad. This city, as is well-known, has now a regular air mail-service with Cairo.

TANGANYIKA.

The report of His Britannic Majesty's Government on the Mandated Territory of Tanganyika for the year 1923, is like all the recent mandate reports on tropical territory, excellent to a degree. Replete with full information on all essential matters it indicates sound progress in nearly every direction, though it is perhaps the position in regard to native education that should attract the average reader's attention most. The schools provided by the Government, and affording free education, are of two classes: Primary Schools and Elementary Schools. The former are situated in the towns and are designed principally to train the African boy for clerkship and junior positions in the Government service. The curriculum in these schools includes instruction in all branches of the English language, translation, geography, mathematics, history and typewriting. From the school at Tanga young Africans have displaced the Asiatic clerks in the Administrative office in less than two years. In most of these schools, moreover, industrial classes are held in carpentry and tailoring; at Dar-es-Salaam, weaving and printing are taught, while bootmakers, blacksmiths and masons are trained at Tanga. The Report states that experience has already proved that the East African is capable of being trained to a high degree of efficiency in these industries. Concerning the Elementary Schools, these provide for the education of the peasantry whose inheritance is the land and for whom the more advanced training which is given to the town-bred native is not suitable. The curriculum includes the three "Rs"—reading, writing and arithmetic—and Kiswahili (coast language), geography and short courses in hygiene. But it is simple instruction in agriculture and the improvement of economic industries and "civics" which is the keynote of the policy of these rural schools. A garden is attached to every school and from the information presented in the report under notice it is clear that these gardens are really effective educationally and valuable instrumentally in the distribution of new crops and better varieties of seeds and live-stock. In all schools demonstrations are given in hygiene and there are regular parades for bathing and the washing of clothes and physical drill and games. Finally the Government also publishes a newspaper for natives at cost price written in Swahili and containing world news, agricultural information, &c.—an essentially instructive journal. This, like the school education is intensely appreciated by the people. Whether all this is the result of former German influence or entirely British, or whether in respect of agriculture and hygiene it is due to the influence of Mr. A H. Kirby, the Director of Agriculture, whose efforts in these directions in the West Indies had much effect, is immaterial, so long as the good work is continued and widely emulated in many other countries.

ABYSSINIA.

The recent visit to Europe of H. H. Ras Taffari, the Crown Prince of this East African State, has been given a great deal of publicity in the press, not only in Europe itself but also in the United States. R. W. Wilson in "The New York Times" (Magazine Section) deals with the matter in a delightful strain of humour, but there is, of course a serious side, which seems to have been neglected. Abyssinia four times the area of Great Britain is a mountainous, largely undeveloped country and needs more railways or at least better transport. Furthermore the country is adjacent to very important British territory—the Southern Sudan, Somaliland, Kenya and Uganda—where large cotton-growing developments are in progress and where political and social quietude are essential. Abyssinia, to the great lamentation of its Regent, is additionally significant on account of the fact that slavery is still practised and legally recognised. Seemingly there is even an external trade in this human traffic between Abyssinia and Central Arabia across the Red Sea. Industrially, Abyssinia produces coffee, sugar, ivory, cereals and some gold, and possesses large numbers of live stock; but the total value of its trade is only about £2,000,000. The people (ten to eleven millions) are fundamentally Semitic, but with pronounced negroid infusion—a natural concomitant of negro slavery. Abyssinia is synonymous with Ethiopia, and the ancient Ethiopians, a Semitic or Hamitic (but not a negroid) people were of course the conquerors of the early Egyptians.

BRAZIL.

The revolution in Sao Paulo—which almost amounted to the status of a civil war—was brought to an end by the Government forces some weeks ago and there still seems so be an almost complete restraint in the matter of press comment as to the probable economic effects, particularly in respect of coffee. The upheaval has probably had a salutary effect and strengthened the hands of the Government, which is desirable at the present time for many important reasons. The formation recently of the Brazil Plantations Syndicate in London, headed by Lord Lovat, signalises active British interest in Brazilian cotton-growing, while the new harbour works at Pernambuco—the chief sugar port—and the projected transcontinental steamer and railway service by the United States are indicative of big developments in a country which has already made astonishing economic progress during the last twenty-five years.

UGANDA.

Mr. A. G. Eckel, attached to one of the British Cotton Growing Association's cotton ginneries in the eastern province of this country has recently arrived in Trinidad and given us interesting information concerning present conditions in regard to cotton. The crop for 1924 is expected to be over 100,000 bales (of 400 lb.) as against 85,000 bales for 1923. The crop is usually bought by the ginneries between the months of December and April and this year the average return to the grower was in the neighbourhood of 30*s*. per 100 lb. of seed-cotton. The opening day for purchase is notified by the Government and each native grower brings in his own cotton on his head. Uganda has an excellent system of roads and baled cotton is transported by motor lorry, lake steamer and rail. This involves handling six or more different times, but this will be obviated greatly by the recent extension of the railway round the lake to tap the top of the eastern province. This year owing to labour difficulties the ginning and transportation of the cotton became a difficult problem for all ginners and shippers, the natives at present not having any incentive nor economic pressure to labour for material gain. The price of cotton in Uganda is based on the Liverpool market but the native cannot understand fluctuations. The present price will probably have to come down and this may tend to reduce the crop. Therefore stabilization of price is desirable and it would seem possible to evolve some practicable system. One other matter needs special consideration, namely ginning. New ginneries are being erected with European and Indian capital, hence the danger of the Protectorate becoming over-ginned will have to be watched. A system of erection restriction based on the estimated production in the various districts, may have to be considered. An average yearly allowance of say, 400-600 tons of seed-cotton per ginnery might be made and results investigated.

JAVA.

T. A. Tengwall and C. E. van der Zyl have established a correlation between rainfall and sugar yield, the sugar yield per bouw being in direct proportion to the amount of rain which falls in the months of October and November. The yield is also dependent upon the time of planting, but this can be allowed for in making computations. The calculation of expected yields for years since 1903 by the authors' formula have agreed closely with the actual yields obtained the maximum difference being only 4·62 per cent. of the actual yield. It will be remembered that a statistical study of the relationship between sugar yield and climatic conditions was made some years ago in Mauritius by A. Walter, Chief Assistant of the Royal Alfred Observatory. He found that there were at least three important factors in Mauritius : rainfall, temperature and high wind velocity, but by a process of correction he established a fair positive correlation between " wetness " (number of rainy days) and cane yield. Similar studies have recently been made in Trinidad at the Imperial College of Tropical Agriculture in regard to rainfall and cacao yield with somewhat surprising results, having something in common with the Javan s gar conclusions.

BRITISH GUIANA.

The official communication of the Government of India on the Colonization Scheme, which has recently been received and published in the local press, seems to leave exceedingly little grounds for hope that the population of the Colony will be substantially increased by the arrival of Indian immigrants for some years to come. While British Guiana may possess certain defects in regard to effective settlement, the text of the Indian Emigration Committee's instructions to be given to the official who is to visit British Guiana in the somewhat distant future strikes one as being a little too ambitious and exacting. That the Colony is suffering from labour shortage is a fact which was recently emphasized at a meeting of the British Guiana Board of Agriculture, one result of which has been a very large shrinkage in the acreage under sugar-cane in 1924. The Colony is further concerned about the deterioration in the quality of rice exported, and consequent loss of part of the West Indian market, and the report of a Committee makes several suggestions as to the causes amongst which may be mentioned defective water-supply both as regards rice-growing and the mills, undesirable cultivation methods, and the absence of satisfactory records of the paddy received at the mills, which are mostly situated on the rice-growing areas ten to twenty miles east and west of the Demerara river, on the coastal flats. It may be noted that the quantity and value of the rice exported in 1923 was 8,894,187 lb. valued at £57,018 compared with 19,694,080 lb. valued at £125,386 in 1922. This shows the great fluctuation that can occur in regard to rice production in the Colony.

ESTATE ACCOUNTANCY.

PROFESSOR W. R. DUNLOP.

[*This, the sixth and concluding article of this series, deals with certain special economic aspects of accountancy and gives an additional instance of the cost-financial system applied to cacao fields. Previous articles have included discussions on the administrative aspect, double-entry, balance sheets valuation, depreciation, cost-financial system and routine records.*]

Statistical Costs.—It was mentioned in the first article of this series that estate accountancy may be divided broadly into three categories (*a*) financial (*b*) cost and (*c*) statistical, but that in practice these merge one into the other. An example of statistical accountancy is afforded by the enquiry made by the writer into the variation during 1922 of money spent on field labour per acre on six different cacao estates in the Montserrat District, Trinidad. These estates are practically adjoining one another, of different areas, but all of about the same age and all possessing similar soil and climatic conditions. The variations per cent. of the mean expenditures for each estate for every month during the year were determined and the curves plotted and the standard deviations calculated. The average expenditure per acre per annum varied between $8 and $12, and the monthly variation has coefficients of variation ranging from 12 to 43 per cent. meaning that the monthly variation on some estates was extremely high. Moreover the biggest increases and decreases on these estates during the year, did not, as one might expect overlap; agronomic operations were apparently done at different times in spite of the estates possessing similar conditions of soil and climate. This was found to be due to labour shortage, one estate using a gang when the other had finished with it and so on—a kind of rotation of labour. The difference in the extreme average expenditure per acre ($8 and $12) was due to financial stringency. Further analysis was made of the ratio of task work to day work, number of man-hours, &c., and still further comparison made in respect of similar factors in other districts. These results proved interesting and enlightening. Another enquiry by the writer has shown the following position in regard to yield of cacao on four large and important estates widely separated and situated under different conditions of soil and climate and known to be differently managed. The figures represent the average annual output during the last five years per cent. of average annual output during previous five years. Estate A, −2·4 per cent.; Estate B, 12·0 per cent.; Estate C, 16·2 per cent.; Estate D, −25·5 per cent. These data indicate the wide differences in the trend of productivity on these Trinidad cacao estates. They have no direct connection with the previous figures and were studied in connection with the correlations of rainfall and yield. Such data are of value, however in the study of statistical costs and management efficiency.

Cost Categories.—With reference to the double-entry cost system shown on page 107 of the Journal for July, it is frequently useful to adopt dividing lines other than those at the end of "production," "manufacture" and "marketing." The accompanying table shows the true cost per barrel of cacao during 1923 on a large Trinidad estate in respect of two different fields. This estate keeps records for each field on the estate, and the apportionments were carefully calculated by the writer and the manager of the estate, in co-operation. The balance shown in each case is the average cost of a barrel of cacao for each field delivered at the sweat box, *i.e.*, at the commencement of manufacture. It will be noticed that the Field II cost is 93 cents per barrel more than the Field I cost in spite of the fact that Field II has a lower *cost per acre.* The reader should later go into these results and find the reasons for them. For the present we are concerned with the question of cost categories, and in this connection the costs in the accompanying accounts may be usefully classified on the following basis:—

Agronomic.	*Standing.*	*Variable.*
Brushing	Nursery	Picking.
Manuring	Taxes	Crooking and
Trimming	Depreciation	Carting.
	Supervision	Supplying.

The agronomic costs are those which physically enter into production, *i.e.*, the cost of producing the crop of pods on the trees ready to be picked. Naturally there is always a (capital) carry-over from year to year. But these expenditures are usually of a routine nature on a well-managed estate and they represent the biological or agronomic cost of production. This category for different estates and for fields on the same estate gives the producing cost per acre, for the varying yield, factor does not enter into it. It is useful for the manager to have the above totals placed before him week by week, especially the agronomic costs which in the case of manuring are all-in costs and not merely the cost of the manure.

Marketing Costs.—Costs following on the f.o.b. costs are generally regarded as the marketing or selling costs and include freight, insurance, commission, duties, &c. These costs are very important and are ultimately paid by the estate; but the estate is not responsible for them unless the estate actually sells (abroad) its own produce. It is in connection with these costs that tariffs and exchange operate. Hence these costs are to some extent *political.*

Cost Standards.—The fundamental economic relationship on an estate is (Total Costs ÷ Total Acreage) ÷ (Total Yield ÷ Total Acreage). That, is, cost per acre divided by yield per acre = cost per unit of produce. Two estates of entirely different sizes and capitalisation may have the same cost per unit of produce (unless the cost includes interest on capital) for the acreage factor cancels out in calculating cost per unit of produce.

ACTUAL COST OF PRODUCTION DURING 1923 IN TWO FIELDS ON A TRINIDAD CACAO ESTATE.

FIELD I.

(10·6 acres; 3,180 piquets=tree positions [1]; ¼-mile from sweat-box.)

	$ c.		$ c.
To Valuation	3,021.00	By Valuation (depreciation 2c. per tree) ..	2,957.40
Wages ("brushing")	28.77	Manufacturing A/C (=cost of production delivered at sweat-box)..	262.02
Do. ("trimming")	16.05		
Do. (apply. art. manure)* ..	2.95		
Do. (for "supplying") ..	3.18		
Do. (for picking, &c.) ..	46.86		
Do. (for "crooking")* ..	2.00		
Manure (potash)	23.42		
Do. (basic slag)	48.35		
Nursery (for supplies)	.20		
Taxes (land)	2.64		
Establishment charges (for field supervision)*	24.00		
	$ 3,219.42		$ 3,219.42

Yield: 70 barrels. *Cost per barrel*: $3.74. *Cost per acre*: $24.72.

FIELD II.

(6·1 acres; 1,827 piquets [2]; ¾-mile from sweat-box.)

	$ c.		$ c.
To Valuation	1,736.00	By Valuation (depreciation 2c. per tree) ..	1,701.28
Do. (brushing in Nov., 1922 carried forward) ..	7.30	Manufacture A/C (=cost of production delivered at sweat-box)..	144.62
Wages ("brushing")	10.17		
Do. ("trimming") ..	12.19		
Do. (apply. art. manure)* ..	1.85		
Do. (for "supplying") ..	1.82		
Do. (picking, &c.) ..	20.46		
Do. ("crooking")* ..	1.40		
Manure (potash)	12.25		
Do. (basic slag)	26.68		
Nursery for (supplies)	.10		
Taxes (land)	1.68		
Establishment Charges (for supervision)* ..	14.00		
	$ 1,845.90		$ 1,845.90

Yield: 31 barrels. *Cost per barrel*: $4.67. *Cost per acre*: $23.70

1. Probably 5 per cent. not producing. 2. Probably 5 to 10 per cent. not producing.

* These costs include proper apportionment of cost of mules, carts and horses used, and depreciation of same. Strictly speaking these included items should be shown separately.

Standards of Production.—In tropical agriculture the three important standards are value of net output per cent. of fixed capital (land, trees, heavy machinery, buildings); net output per cent. of working capital (remaining assets): and value of net output per labourer employed. These enable the economic efficiency of estates to be measured and compared. They are readily and easily calculated from the accounts recommended in previous articles.

To Analyse a Balance Sheet.—Very few privately-owned estates draw up a proper balance sheet so that generally speaking the estate balance sheets one meets with are those of either private or public Companies. In these the following points are amongst those that should be inquired into: (1) the nature and amount of the Profit and Loss Balance and the underlying costs, yields and market prices that gave rise to it; (2) the relative proportions of "fixed," "floating" and "liquid" assets and the basis on which the valuations are made: it must be remembered that these valuations in a purely *financial* balance sheet should be financial (cost or market price whichever is the lower); (3) as regards liabilities, the auditor must distinguish between capital in the form of shares, accumulated balances or reserves, and liabilities to outside creditors. Liabilities of a special character, such as a bank overdraft or loans secured on assets should be carefully noted and the reasons for their existence inquired into. In general, an estate balance sheet must be considered as a financial statement which invariably raises points that require technical explanation and analysis before the balance sheet can be really convincing. The

Profit and Loss Account which usually accompanies a Balance Sheet assists or should assist in supplying this information.

Acknowledgments.—I have gratefully to acknowledge the assistance rendered in the preparation of this series of articles, other than by those persons already mentioned in the course of the text. The cost-financial system in article IV is based upon principles and examples kindly explained to the writer last year at the Institute for Research in Agricultural Economics, Oxford, by Mr. Holmes in respect of English Agriculture. To Mr. A. Kerr, A.C.A., of Messrs. Fitzpatrick Graham & Co., Chartered Accountants, London and Trinidad, I am indebted for kindness in reading over the MSS. of these articles and for making several minor suggestions. I am indebted also to the managers and proprietors of cacao, sugar, coconut and rubber estates in Trinidad for allowing me access to their books and permission to make use of their data for purposes of education and inquiry. Mr. C. Roach, Agricultural Adviser to the small planters and Mr. L. A. Brunton (Trinidad Department of Agriculture) gave me the benefit of their advice in regard to the account sheet for peasant proprietors given in the second article p. 77.

POSITION OF FIBRE PRODUCTION.

[*The following paper by Dr. E. Goulding, D.Sc., (Lond.) F.I.C., Superintendent of Investigations Imperial Institute, and well-known technical authority on fibres, was read at a Conference held in connection with the Sixth International Exhibition of Rubber and other Tropical Products at Brussels last April, the proceedings in connection with Rubber having been summarised in "Tropical Agriculture" for June.*]

The well-known cordage fibre, Sisal hemp, is derived from the leaves of certain species of Agave. The name is now usually restricted to the product of *Agave sisalana*, Perr. (*A. rigida*, Miller, var. *sisalana*), although it was first applied to the fibre produced in Yucatan, Mexico, mainly from the leaves of *A. fourcroydes*, Lem. (*A. rigida*, Miller, var. *elongata*, Jacobi). The latter fibre is commonly distinguished as "Henequen," or "Mexican Sisal."

The true Sisal hemp plant is a native of Central America, but has been introduced into most tropical countries, including Florida, the West Indies, South Africa, East Africa, West Africa, Madagascar, Mauritius, India, Indo-China, the Dutch East Indies, the Philippine Islands, the tropical parts of Australia, Papua, Fiji and Hawaii.

The earliest efforts to introduce the fibres into commerce were concerned with henequen and were made in Mexico in 1839. It was found, however, that the preparation of the fibre by the primitive methods then employed was so slow and tedious that even with the cheap labour available the cost of production was discouraging. Some years later a simple machine was invented, and its employment led to a gradual expansion of the industry.

It is estimated that the annual production of fibre in Mexico is now about 150,000 tons when the plantations are working at their full capacity. A large proportion of the product (probably over 90 per cent.) is exported to the United States, where it is employed for the manufacture of the binder twine used in harvesting the immense grain crops of the Western States. The present demand for binder twine for this purpose amounts to about 200 million lb. annually. The output of fibre from Mexico has not been seriously reduced by the political and military disturbances of recent years, but during the latter half of 1923 transport difficulties occurred owing to the revolution and the occupation of the country by the rebels, and exports temporarily ceased. As a result of the uncertainty of Mexican supplies, European manufacturers have turned their attention to African Sisal hemp, and it is probable that they will continue to use this in preference to the Mexican product unless substantial advantages are offered. In any case it is unlikely that in future there will be much Mexican fibre available for the European market after the needs of American consumers have been fully met.

It is evident that in order to ensure a sufficient supply of Sisal hemp for the needs of European manufacturers, the production in countries other than Mexico should be greatly increased and the industry introduced if possible into new regions.

It has therefore been considered of interest to give a brief account of the efforts which have been made to establish Sisal hemp cultivation within the British Empire, together with an indication of the present position and prospects of the industry in each of the countries in which the growth of the crop has been attempted.

It will be seen that the only British countries at present producing the fibre on an extensive scale are East Africa (Kenya and Tanganyika) and the Bahamas, but that commercial supplies may be expected in the near future from Ceylon, Nyasaland, Gold Coast, Mauritius and Jamaica. Several other countries are well adapted to the crop and have extensive areas available for cultivation.

The results of the attempts to develop a Sisal hemp industry in these various countries have confirmed the view that the crop cannot be profitably produced unless the operations are carried out on a large scale and with the employment of modern machinery. As one extraction machine is capable of preparing from 500 to 600 tons of fibre per annum and the average production of the fibre is about 1 ton per acre, it is evident than an area of from 500 to 600 acres of mature plants must be annually available for each. As the plants take some years to come to maturity and are only available for cutting for a limited period, it is obvious that fresh areas must be

planted in succession in order that the machines may be continuously supplied. This question need not be considered in fuller detail as an excellent discussion of the subject has been published by Major L. A. Notcutt, M.C., A.R.S.M. in a supplement to the issue of *Tropical Life* of April, 1923. Major Notcutt, who has had considerable experience of Sisal hemp growing in Portuguese East Africa and has also studied the question in Kenya and Tanganyika, recommends the planting of a fresh section of 600 acres each year, and suggests a scheme which would involve the planting of a total area of 7,200 acres and the installation of six extraction machines. This he considers should be regarded as the minimum scale of operations for the establishment of a profitable industry.

Tanganyika.—The Sisal hemp plant was introduced into German East Africa (now Tanganyika) in 1893. In that year the German East Africa Company ordered 1,000 plants from Florida, but only 62 of them survived the journey. These were carefully tended in a plantation at Kikogwe, and new plants were propagated from them so that in 1898 the number had increased to 63,000. In 1899 machinery was introduced for extracting the fibre. By the beginning of 1900, no less than 150,000 plants had been established, of which 4,000 were more than three years old and were ready for cutting. The first shipment of fibre was made in 1900 and amounted to 7½ tons. From this time forward the industry progressed with remarkable speed, as is shown by the following statistics of exports (in metric tons) during the years 1905-1913:

1905	1906	1907	1908	1909	1910	1911	1912	1913
1,397	*1,854*	*2,830*	*3,897*	*5,284*	*7,228*	*11,213*	*17,079*	*20,835*

In 1912 the total area planted with Sisal hemp amounted to 61,162 acres.

The industry was seriously affected by the war, and on the establishment of British administration in 1920 it was found that many of the best plantations had undergone serious deterioration. The situation is being gradually retrieved, but some years must elapse before the industry has fully recovered its pre-war position.

The exports in 1922 amounted to 10,224 tons, of which the greater part was shipped from Tanga and a small quantity from Lindi. Of this amount, about 48 per cent. was consigned to the United Kingdom, 25 per cent. to the Continent of Europe and 25 per cent. to the United States. There is no doubt that the production will rapidly increase. Standard grades have now been established and this policy has facilitated the marketing of the crop by increasing the confidence of importers.

The Sisal hemp produced in Tanganyika is of excellent quality and realises the highest prices, being usually quoted at about 10 per cent. in advance of Mexican Sisal.

Kenya Colony.—The cultivation of Sisal hemp in British East Africa (now Kenya Colony) was begun in 1903, trials being first made in the Nairobi District and a little later in other parts of the country. Excellent results were secured and the encouragement thus obtained led to a gradual extension of the industry. It was found that plants grown at the coast yielded a higher percentage of fibre than those grown in the Highlands and also furnished a finer fibre, but that in the Highlands a larger yield per acre was obtained and the cost of labour was less. In 1913 about 7,000 acres had been planted; in the year 1913-14 the exports of fibre amounted to 1,073 tons and in the following year to 1,681 tons.

In 1916-17 there were about 15,000 acres devoted to the crop whilst in 1921 the area had more than doubled, amounting to no less than 31,050 acres, distributed as follows: *Kenya Province.* Fort Hall, 8,924 acres. *Naivasha Province.* Eldama Ravine, 500 acres; Naivasha, 648 acres; Trans Nzoia, 607 acres; Uasin Gishu, 4 acres. *Nyanza Province.* Kisumu, 2,304 acres. *Seyidie Province.* Malindi (Kilifi), 1,340 acres; Mombasa, 1,600 acres; Vanga, 1,080 acres; Voi, 2,288 acres. *Ukamba Province.* Kikuyu (Kyambu) 3,465 acres; Machakos (Ulu), 7,737 acres Nairobi, 553 acres.

In 1922 the total area increased still further to 37,118 acres and the production for the year ending June 30, 1922, was 4,677 tons.

The greater part of the Sisal hemp produced in Kenya is exported to the United Kingdom. Improvements made in the last few years in the organisation and management of labour and the increase in the output of the factories have effected considerable economies in the cost of production and these factors, in conjunction with a lowering of the transport rates, have enabled the industry to be carried on profitably even when the market prices of the fibre are comparatively low.

There is a vast area of land in Kenya which is well adapted for Sisal hemp growing, and the further expansion of the industry depends chiefly on the introduction of capital and the supply of the necessary labour.

Uganda.—Sisal hemp plants have been grown with success in the Botanic Gardens at Entebbe and a sample of fibre forwarded to the Imperial Institute was of excellent quality. There are enormous areas in Uganda which would doubtless be well suited to the production of the fibre on a large scale.

Nyasaland.—Sisal hemp has been found to grow well on loose sandy soils in all parts of Nyasaland, but the cultivation of experimental plots at various altitudes in the Protectorate has shown that the best results are obtainable at elevations not exceeding 2,500 ft. The industry is now being carried on as a commercial enterprise and the outlook is very promising.

In the Ruo District, Sisal hemp is being grown on the lower levels between Sankulani and Chiromo. Large plantations have been established at Chiromo and considerable success has been achieved It was reported in 1922 that 100 tons of fibre

had been exported from these estates and that very favourable reports had been received regarding the quality of the product. The factory is run entirely by water power, and the power available is sufficient to admit of operations on a much larger scale. It is anticipated that the production of fibre will be greatly increased.

In the Lower Shiré District there is a Sisal hemp plantation of about 1,000 acres which is situated about 4 miles above Port Herald and has recently reached the producing stage.

Zanzibar.—The Sisal agave thrives well on the islands of the Zanzibar group and fibre from this source has been favourably reported on.

Mauritius.—This island is well known as the source of Mauritius hemp or "aloe" fibre, derived from the leaves of *Furcraea gigantea.* The production of this fibre forms an important industry which has been existence for about fifty years.

As the Sisal agave furnishes a product superior to the ordinary Mauritius hemp and also usually gives a higher percentage of fibre from the leaves, it seemed not improbable that its cultivation might prove more profitable than that of *Furcraea.* Some years ago, therefore, certain areas were planted with Sisal in order to compare the possibilities of the two crops. In general, these Sisal plantations gave favourable results although in some cases the growth was irregular. The fibre produced was of good quality, and small quantities which were exported realised satisfactory prices in the European markets. It was found, however, that the sisal plantations required more attention in the early stages of growth than the Furcraea plantations.

Continued interest is being taken in the substitution of Sisal cultivation for that of Furcraea. A planter in the north of the Island has established a plantation of about 300 acres and has imported machinery for extracting the fibre.

(*To be continued.*)

PREVENTION OF THE OVER-ENLARGEMENT OF HEADS OF PINE.—In the May issue of *L' Agronomie Coloniale,* it is remarked that there is a good market in France for the pineapple which, if a product of the Colonies, is imported duty free. It is claimed that the most satisfactory variety for export is the "Smooth Cayenne." Pineapples both cultivated and uncultivated often have the head of leaves over-developed and this is naturally detrimental to the fruit. Two methods are suggested for preventing the over-development of the head thus increasing the commercial value of the fruit. One is by nipping off the buds, or extracting with a small wooden spatula the eye of the central leaf, and the other is by dropping in the centre of the leaf a small quantity of sulphuric acid. Care should be taken with both these methods not to cause injury to the fruit itself; the operation should be performed when the fruit is half ripe, at which stage the head tends to over-develop.

THE SMITHSONIAN INSTITUTION.

[*The Smithsonian Institution is essentially an educational force whose object is the diffusion of scientific research of the wide and inspiring kind in simple language. Much of the Institution's literature deals with the history of tropical man and his surroundings.*]

The Smithsonian Institution created by act of Congress in 1846, according to the terms of the will of James Smithson of England, who in 1826, bequeathed his property to the United States of America "to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men," covers a wide range of activities embracing various sciences.

This is amply illustrated by a brief résumé of the field work for the year 1922 which comprised geological explorations in the Canadian Rockies, paleontological work in Tennessee, examination of the North Pacific Fur Seal Islands, and a botanical expedition to Colombia, the collection resulting from which being the largest and most important ever obtained from that country. The paleolithic regions of France and Spain were explored by Mr. M. W. Stirling who is of the opinion that this region, far from being exhausted archeologically contains miles of relic-bearing deposits. Many of the caverns found were blocked with sediment, a very fortunate accident of nature, since the contents are by this means preserved intact. Scientific experiments in this line should yield most fruitful results.

Rooms in the New National Museum have been set aside for exhibits of the fauna and flora of the District of Columbia, and in these has been installed stereomotorgraphs which alternately shows series of pictures of plants and birds, the plants as they come into flower and the birds about their nest, feeding stations, or bird baths.

By act of Congress $44,000 were voted for ethnological researches among the American Indians and the natives of Hawaii. The epoch-making discoveries in the Valley of the Tombs in Egypt have greatly increased interest in the Science of Man and never before have accurate accounts of Indian life, like those published by the Bureau of American Ethnology been more in demand than at the present time. It is planned to repair one of the old Indian villages for educational purposes while the excavation of pipe Shrine House, a building in the Mummy Lake group of mounds was completed and the ruin repaired and opened to inspection by visitors.

The Astophysical Observatory also received $15,500 for its upkeep, &c., under the independent offices appropriation act.

An outstanding event of the year was the formal opening on May 2, 1923, of the Freer Gallery of Art, Mr. Charles L. Freer's splendid gift to the Nation, through the Smithsonian Institution, of his unrivalled collections of American and Oriental Art and a beautiful building to house them.

Through its publications also the Institution carries out one of its primary functions "the diffusion of knowledge among men." Many of its publications are the results of scientific researches conducted by members of the staff, others are prepared by outside scientists, and still others are intended for the general reader who takes an interest in the progress of science, but is not benefited by the more technical papers. The Institution issued 100 volumes and pamphlets of which 139,666 were distributed.

ORIGIN OF SUGAR-CANE SEEDLING D. 1135.—Demerara 1135 is one of those very few thick cane varieties or seedlings which has proved markedly resistant to infection by and tolerant of Mosaic Disease and for this and other reasons it has been cultivated to an important extent in the Hawaiian Islands and Australia for many years. It is also under cultivation in the Philippines and Argentine and has been introduced within recent years into the West Indies.

It was one of a batch of Demerara seedlings imported direct into Queensland by Young Brothers of Fairymead in 1895 and its subsequent introduction to other sugar-cane territories was from Queensland. Doubt has been expressed as to whether the number by which it is commonly known was its original number in Demerara—its origin in fact, has been obscure.

Mr. R. A. Altson has recently examined early records of seedling work by the Department of Agriculture in British Guiana and has kindly furnished information regarding the origin of this cane. Mr. Altson writes :—

"In the autumn of 1889 a group of fifty-five plants was raised here from some seed and seedling plants of unknown parentage introduced by (Sir J. B.) Harrison from Dodd's Botanical Station in Barbados. One of this group which came to maturity in 1891 was a cane D. 103 described as whitish-green. In the autumn of 1892, 384 plants were raised from this seedling, of these 197 were planted out and among the 74 selected for analysis (presumably in 1894) was one—D. 1135 described as pinkish-bronze. Somewhere between 1895 and 1902 this cane was discarded.

"The dates fit in fairly well. A seedling raised in the autumn of 1892 would be mature late in 1894 and cuttings from this would not reach Queensland until 1895.

"Finally, of the thirty-one other seedlings listed by Easterby (Varieties of Sugar-cane in Queensland 1915) as being introduced with D. 1135 I find that thirteen were raised in the same year (1892) and two—D.1070 and D. 1035 were from the same parentage D. 103."

It may be added that Easterby's list records this parent of D. 1135 as having been introduced into Queensland by Young Brothers in 1898 in another batch of Demerara seedlings.

S. F. ASHBY.

COLLEGE NEWS.

Dr. H. Martin Leake, M.A., SC.D., F.L.S., arrived in Trinidad on August 23, and assumed the duties of his office as Principal and Commissioner of Agriculture.

The Governing Body has invited Sir Francis Watts, K.C.M.G., D.SC., to accept the title of Principal Emeritus.

During August the College was visited by Professor A. E. Emerson, Department of Zoology, University of Pittsburg, Pa., who, with a number o Post Graduate Students was returning to the United States from Dr. Beebe's Research Station up the Essequibo in British Guiana.

Mr. W. R. Dunlop has resigned his position as Professor of Economics at the College in order to pursue, under requisite circumstances, the study and investigation of a special group of tropical economic and political problems. Mr. Dunlop sails for England on September 16, and a successor, who has been appointed, is expected to arrive before the beginning of the new Session.

Professor Ashby returned from England on August 2, and proceeded to St. Lucia on August 23, in connection with official mycological duties.

Dr. C. L. Withycombe, PH.D., Mr. E. E. Cheesman, B.SC., and Mr. P. E. Turner, B.SC., returned on August 15, from Tobago where they had been making scientific observations of a general nature.

The 1924-25 Session begins on October 1. (Supplemental examinations September 29.)

AIRSHIPS VERSUS AEROPLANES.—For long distances, and especially across great stretches of sea, desert, and forest, the lighter-than-air vessel has an advantage over the heavier-than-air. It can carry fuel for over three thousand miles of a voyage while still having a large enough load of passengers, mails, or parcels to make it a paying concern. The heavier-than-air machine can only take comparatively short flights, because, fuel being so heavy, it can only make goods pay by cutting down the amount of fuel to be carried. The lighter-than-air machine defeats the force of gravity without any expenditure of petrol, but the heavier-than-air machine has to use its fuel to conquer gravity in addition to propelling the machine on its course over the surface of the earth. The heavier-than-air vessel can land almost anywhere, while the lighter-than-air has to have a special mooring-mast or shed, with a considerable ground party to moor it. Consequently, for short distances the aeroplane is more practical than the airship. It also has an advantage of speed. Again, it is the only type useful for a comparatively short journey to be taken by one or a very small number of passengers, or for a long journey on which there are no stations fitted for lighter-than-air craft.—(Admiral Mark Kerr, C.B., M.V.O., in the *Saturday Review* for June 28, 1924.)

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—For the last two or three months raw sugar has been dull at about $5.10 for Cubans, duty paid, in New York. Towards the middle of August prices advanced and a basis of $5.40 New York may be quoted for August 15. It may be pointed out that sugar has shown a steadily declining tendency since March.

COTTON.—During August fully middling declined from 18·6*d.* to 16·2*d.*, Liverpool at August 18. Owing to the premium due to uncertain weather conditions in the Southern States, spinners in Lancashire have been buying only when compelled. A considerable increase in Empire grown cotton would appear to be likely this year as compared with last.

CACAO.—During August the cacao market has taken a distinct upward trend after over two months of depression. Trinidad cacao is selling at $11.00 per fanega, while for New York the price quoted is 11*c.* per lb. Accras, 27*s.* 6d. to 30*s.* per cwt. (July 16).

COFFEE.—After falling to 84*s.* per cwt. on June 18, Brazilian Santos in London rose to 96½*s.*, July16. The general rise of several shillings per cwt. for Brazilian coffee has been due to political causes as forecasted in the last issue of this journal.

TEA.—The Indian average underwent a sharp rise towards the middle of July reaching 19*d.* per lb. but has since declined to 18-18½*d.* The market on the whole may be regarded as strong. There is firmness but not activity in Ceylon, Assam, and Java tea.

SISAL.—Since last August the price of prime sisal in London has followed the course of a horizontal S-shaped curve being highest last May and lowest during last October. Price, July 16, £44 10*s.* per ton. The market on the whole is dull compared with two months ago.

RUBBER.—The price of Plantation Crepe has shown an appreciable improvement after a considerable period of depression and reached 1*s.* per lb. on July 16. which was the price at the end of last March.

RICE.—Burmese has been steady with a declining tendency at £15 10*s.* per ton. The London stocks are larger than last year which is causing a weakness in the market.

COPRA.—The price of prime Copra in London at the beginning of July was £30 10*s.* per ton. The market has been strengthening after the relapse in April and May.

CITRUS PRODUCTS.—On July 17, there was no improvement in the enquiry for concentrated lime juice in London and was quite neglected. Raw, in spite of warm weather, attracted no attention. Distilled lime oil at 5*s.* to 5*s.* 3d. per lb. was more readily saleable than hand pressed which was quoted nominally at 8*s.* per lb. Orange oil, about 8*s.* 6*d.* for Jamaica sweet; at 7*s.* 6*d.*, c.i.f. for Jamaica bitter. Concentrated lime juice was steady in New York at the beginning of July.

BALATA.—The London market at July 17, was quiet but prices were firmly maintained. West Indian sheet at 3*s.* 3½*d.* c.i.f. the value on landed terms being 1½*d.* per lb. above this figure.

SPICES.—The market both in London and New York was somewhat of a hand to mouth character during July but was expected to exhibit a more active tone in August.

OVER-PRODUCTION.—It is well known that at the present time at least two important tropical industries are suffering from over-production, namely, the cacao industry and the rubber industry. In spite of this many promoters of agricultural research in Great Britain persist indiscriminately in encouraging increased tropical production by means of manuring, extra cultivation and the application of "science." It is worth noting what David F. Houston says, in regard to America, in *Harper's Magazine* for June: "Some of our most acute financial and economic problems have grown out of the fact that our farmers are producing more than they can market at a profit. There is an ignorant notion that there can be an unlimited number of farmers. This might be proved if every farmer produced only what he consumed and was self-sufficient. But to-day the farmer produces many times what he consumes. We need just as many farmers as will produce what the market will take at a price which pays them to produce it, and no more. Economic forces will maintain in the long run a proper balance between our urban and rural population and production." It will be evident to most people that to advocate increased production at a time of over-production is simply to make matters worse by delaying the cure, namely economic adjustment in respect of the law of supply and demand.

Of the kapok gathered in Java most comes from trees planted originally for other purposes. The greater part of the crop is only a by-product for the trees are planted on either side of the road to protect cacao and coffee plantations. Even when planting is done for the sake of the tree itself, the main purpose is to use the tree as a prop for pepper plants. The export of kapok from Java is estimated at about 10,000 tons a year, and of this quantity 9,400 tons are furnished by kapok trees planted to shelter and prop other plants. Kapok has been recommended on frequent occasions as an industry for the West Indies. The Silk Cotton tree from which kapok is derived is a common species.